

California Environmental Protection Agency



Air Resources Board

Vapor Recovery Test Procedure

TP - 201.3

**DETERMINATION OF 2 INCH WC STATIC PRESSURE
PERFORMANCE OF VAPOR RECOVERY SYSTEMS OF
DISPENSING FACILITIES**

Adopted: April 12, 1996

**California Environmental Protection Agency
Air Resources Board**

Vapor Recovery Test Procedure

TP-201.3

**Determination of 2 Inch (WC) Static Pressure Performance of
Vapor Recovery Systems of
Dispensing Facilities**

1 APPLICABILITY

Definitions common to all certification and test procedures are in:

**D-200 Definitions for
Certification Procedures and
Test Procedures for
Vapor Recovery Systems**

For the purposes of this procedure, the term "ARB" refers to the State of California Air Resources Board, and the term "ARB Executive Officer" refers to the Executive Officer of the ARB or his or her authorized representative or designate.

This applicability of test procedures for static pressure performance is:

TP-201.3 (for new installations of systems certified by CP-201)

TP-201.3A (for existing installations of systems certified by earlier versions of CP-201)

TP-201.3B (for aboveground storage tanks)

Excessive leaks in the vapor recovery system will increase the quantity of fugitive hydrocarbon emissions and lower the overall efficiencies of both the Phase I and Phase II vapor recovery systems.

This test procedure can be used to quantify the vapor tightness of vapor recovery systems installed at any gasoline dispensing facility (GDF) equipped with pressure/vacuum (P/V) valves, provided that the designed pressure setting of the P/V valves is a minimum of 2.5 inches water column.

For those systems equipped with a P/V valve(s) allowed to have a designed minimum cracking pressure less than 2.5 inches water column, and for systems with no vapor vent valve; any valve(s) shall be removed and the vent pipe(s) plugged during this test.

2 PRINCIPLE AND SUMMARY OF TEST PROCEDURE

The entire vapor recovery system is pressurized with nitrogen to two (2.0) inches water column. The system pressure is then allowed to decay and the pressure after five (5) minutes is compared with an allowable value. The allowable five-minute final pressure is based on the system ullage and pressure decay equations. For the purpose of compliance determination, this test shall be conducted after all back-filling, paving, and installation of all Phase I and Phase II components, including P/V valves, has been completed. Requirements for three different points of entry for nitrogen are given in the procedures.

3 BIASES AND INTERFERENCES

3.1 Pressurizing Gas

3.1.1 Nitrogen Flowrate

Do not introduce nitrogen into the system at flowrates exceeding five (5) CFM.

Introduction of nitrogen into the system at flowrates exceeding five (5) CFM can bias the results of the test toward non-compliance.

3.1.2 Gases other than Nitrogen

Do not introduce anything except gaseous nitrogen into the system.

Introduction of gases other than nitrogen into the system can bias the results of the test toward compliance.

E.g., do not introduce liquid nitrogen into the system and do not introduce oxygen, air, helium, argon, etc. into the system.

3.2 Timing

3.2.1 A/L Test (TP-201.5)

Do not perform this test within twenty-four (24) hours of the application of TP-201.5 to the system.

For assisted Phase II systems, the A/L test introduces air into the system. Air contains oxygen which, when introduced into the system, biases results toward compliance for as much as twenty-four hours after introduction.

3.2.2 Deliveries to the Facility

Testing shall occur a full three (3) hours after the last delivery to the facility, and no dispensing shall occur during the test; otherwise a determination of compliance shall not be allowed.

For all Phase II systems, deliveries of liquid fuel to the facility during testing or less than three hours immediately prior to the test can bias the test toward compliance due to thermally induced

molar increase of vapor.

Therefore, if product delivery occurs less than three hours immediately prior to the test, this test procedure can only be used to determine failure to meet a performance specification.

However, the violation of these conditions does not invalidate a determination of non-compliance.

3.2.3 Dispensing to Vehicles

Testing shall occur a full thirty (30) minutes after the last dispensing episode at the facility, and no dispensing shall occur during the test; otherwise a determination of compliance shall not be allowed.

For assisted Phase II systems, product dispensing during testing or less than thirty minutes immediately prior to the test can bias the test toward compliance due to molar increase of vapor subsequent to forced ingestion of air by the assist pump.

However, the violation of these conditions does not invalidate a determination of non-compliance.

3.3 Initial Pressure

A bias toward compliance can result if the initial pressure at the beginning of the five minute pressure decay period exceeds 0.5"WC.

- (1) At the beginning of any thirty minute no-dispensing period, measure the pressure of the air and vapor mixture in the system; if the pressure exceeds 0.5 "WC, slowly reduce the system pressure in a manner which complies with all applicable safety codes.
- (2) At the end of any thirty minute no-dispensing period, measure the pressure of the air and vapor mixture in the system; if the pressure exceeds 0.5 "WC, slowly reduce the system pressure in a manner which complies with all applicable safety codes.

Promptly execute the pressure decay test according to §8 (1)-(3).

3.4 Manifolding

When vent pipes from multiple storage tanks are manifolded, the ullage tested is effectively increased; the results are biased toward compliance. If vent manifolding is absent, a similar but

smaller effect is caused by vapor return line manifolding. For consistent testing of subsequent installations of the system after certification testing, the following manifolding requirements shall be included in the ARB Executive Order:

| | Certified System | Subsequent Installations |
|-------------------------------|------------------|--------------------------|
| Vent Manifolding | yes | yes |
| Vapor Return Line Manifolding | yes or no | yes or no |
| Vent Manifolding | no | no |
| Vapor Return Line Manifolding | yes | yes |
| Vent Manifolding | no | no |
| Vapor Return Line Manifolding | no | no |

3.5 Incinerators

For vacuum-assist Phase II systems which utilize an incinerator, the processor must be isolated and the vapor system/incinerator connection capped. Otherwise, leakage at this point can erroneously indicate a system component leak.

3.6 In-Line Assist Pumps

For vacuum-assist systems which locate the vacuum producing device in-line, between the Phase II vapor riser and the storage tank, the following shall apply:

- (1) A valve shall be installed at the vacuum producing device. When closed, this valve shall isolate the vapor passage downstream of the vacuum producing device.
- (2) The storage tank side of the vacuum producing device shall be tested in accordance with the procedures outlined in this method. Compliance shall be determined by comparing the final five-minute pressure with the allowable minimum five-minute final pressure from the first column (1-6 affected nozzles) in Table 2 or use the corresponding equation in § 11.2.
- (3) The upstream vapor passage (nozzle to vacuum producing device) shall also be tested.

4 SENSITIVITY, RANGE, AND PRECISION

4.1 Sensitivity

4.1.1 Inclined Liquid Manometers and Electronic Pressure Meters

Maximum incremental graduations at, above, and below a pressure observation shall be 0.01 inches water column ("WC).

Each such graduation shall be defined as the resolution, P_{Res} , of a pressure observation.

The maximum bias shall be plus-or-minus one-half percent ($\pm 0.5\%$) of full-scale.

4.1.2 Mechanical Spring Diaphragm Pressure Gauges

The minimum diameter of the pressure gauge face shall be 4 inches.

Maximum incremental graduations at, above, and below a pressure observation shall be 0.05 "WC.

Each such graduation shall be defined as the resolution, P_{Res} , of a pressure observation.

The maximum bias shall be plus-or-minus two percent ($\pm 2\%$) of full-scale.

4.2 Range

4.2.1 Pressure

The pressure range for Tables 1 and 2 is 0.44 to 1.95 inches water column ("WC).

4.2.2 Volume Flow

The minimum and maximum nitrogen feed-rates, into the system, shall be one (1) and five (5) CFM, respectively.

4.3 Precision

The precision of a pressure observation shall affect the compliance status of a system as described below, where:

$P_{req@t}$ = pressure requirement, at a specified time, per the appropriate certification procedure, rounded to the nearest integral multiple of P_{Res} ,

and

$P_{obs@t}$ = pressure observation, at the specified time.

The precision for a pressure observation shall be one-half of P_{Res} .

$P_{obs@t}$ shall be an integral multiple of P_{Res} .

Non-Compliance with a pressure requirement shall be determined when, at a specified volume flow:

$$P_{Req@t} - P_{Obs@t} \geq P_{Res}.$$

5 EQUIPMENT

5.1 Pressure Meters

At least two types of pressure meters can meet the specifications of § 4:

- (1) inclined liquid manometers and
- (2) electronic pressure meters using pressure transducers.

Use a pressure measuring device (transducer, inclined manometer or Magnahelic gauge) with a design range suitable for the pressure being measured.

5.2 Nitrogen

Use commercial grade nitrogen in a high pressure cylinder, equipped with a two-stage pressure regulator and a one psig pressure relief valve.

5.3 Flowmeter

Use a Dwyer flowmeter, Model RMC-104, or equivalent, to determine the required pressure setting of the delivery pressure gauge on the nitrogen supply pressure regulator. This pressure shall be set such that the nitrogen flowrate is between 1.0 and 5.0 CFM.

5.4 Stopwatch

Use a stopwatch accurate to within 0.2 seconds.

5.5 "T" Connector Assembly

See Figures 1 for example.

5.6 Vapor Coupler Integrity Assembly

Assemble OPW 633-A and 633-B adaptors, or equivalent, as shown in the Figures for an example. If the test is to be conducted at the storage tank Phase I vapor coupler, this assembly shall be used prior to conducting the static leak test in order to verify the pressure integrity of the vapor poppet. The internal volume of this assembly shall not exceed 0.1 cubic feet.

5.7 Vapor Coupler Test Assembly

Use a compatible OPW 634-B cap, or equivalent, equipped with a center probe to open the poppet, a pressure measuring device to monitor the pressure decay, and a connection for the introduction of nitrogen into the system. See the Figures for an example.

5.8 Combustible Gas Detector

A Bacharach Instrument Company, Model 0023-7356, or equivalent, may be used to verify the pressure integrity of system components during this test.

5.9 Leak Detection Solution

Any liquid solution designed to detect vapor leaks may be used to verify the pressure integrity of system components during this test.

6 CALIBRATION PROCEDURE

Follow manufacturers instructions.

7 PRE-TEST PROTOCOL

7.1 Safety

The following safety precautions shall be followed:

- (1) Only nitrogen shall be used to pressurize the system.
- (2) A one psig relief valve shall be installed to prevent the possible over - pressurizing of the storage tank.
- (3) Use a ground strap during introduction of nitrogen into the system to avoid static discharge.

7.2 Points of Entry for Nitrogen

For GDF equipped with a coaxial Phase I system this test shall not be conducted at a Phase II vapor riser. For GDF which utilize a two-point Phase I system this test may be conducted at either the vent pipe or a Phase II riser. Also, this test may be conducted at Phase I vapor coupler, provided that the criteria set forth below have been met.

7.3 Check Facility Operating Mode

7.3.1 General Requirements

Be prepared to test at least two modes of facility operation:

(1) Phase I Mode

Except as noted below, The Phase I mode shall be tested with:

- (a) spill containment box covers **removed**, with
- (b) Phase I fill pipe caps **removed**, and with:
- (c) Phase I vapor return line caps **removed**.

For spill containment boxes with cover-actuated drain valves, an additional test shall be performed with:

- (a) spill containment box covers *installed*, with
- (b) Phase I fill pipe caps **removed**, and with:
- (c) Phase I vapor return line caps **removed**.

(2) **Phase II Mode**

Except as noted below, the Phase I mode shall be tested with:

- (a) spill containment box covers *installed*, with
- (b) Phase I fill pipe caps **removed**, and with:
- (c) Phase I vapor return line caps *installed*.

For spill containment boxes with cover-actuated drain valves, an additional test shall be performed with:

- (a) spill containment box covers **removed**, with
- (b) Phase I fill pipe caps **removed**, and with:
- (c) Phase I vapor return line caps *installed*.

7.3.2 Specific Requirements

- (1) Product dispensing shall not occur during the test. There shall have been no Phase I deliveries into or out of the storage tanks within the three hours prior to the test. For vacuum-assist Phase II systems, see § 2 regarding biases and interferences.
- (2) Measure the gallons of gasoline present in each underground storage tank and determine the actual capacity of each storage tank from facility records. Calculate the ullage space for each tank by subtracting the gasoline gallonage present from the actual tank capacity.
- (3) For two-point Phase I systems, this test shall be conducted with the dust cap removed from the vapor coupler. This is necessary to determine the vapor tightness of the Phase I vapor poppet. See item (6) if this test is to be conducted at the Phase I vapor coupler.
 - (a) For coaxial Phase I systems this test shall be conducted with the dust cap removed from the Phase I coupler. This is necessary to insure the vapor tightness of the Phase I vapor poppet.
 - (b) Verify that the liquid level in the storage tank is at least four (4) inches above the highest opening at the bottom of the submerged drop tube.
- (4) If the Phase I containment box is equipped with a drain valve, the valve assembly may be cleaned and lubricated prior to the test. This test shall, however, be conducted with the drain valve installed and the manhole cover removed. See § 8 (5) for further details regarding containment box drain valves.

- (5) If the test is to be conducted at a Phase II vapor riser, disconnect the dispenser end of one vapor recovery hose and install the "T" connector assembly (see Figure 1 for example). Connect the nitrogen gas supply (do not use air) and the pressure measuring device to the "T" connector.

For those Phase II systems utilizing a dispenser mounted remote vapor check valve, the "T" connector assembly shall be installed on the vapor riser side of the check valve.

- (6) If this test is to be conducted at the Phase I vapor coupler on a two-point Phase I system, the procedures set forth in (a) and (b), below, shall be successfully completed prior to testing. The static leak test shall not be conducted at the Phase I coupler on coaxial Phase I systems.

Compliance with the requirements given below is based on pressure meter readings. Alternatively, liquid leak detection solution (e.g. soapy water) can be applied to the tested equipment. In this alternative, compliance is based on ocular non-detection of bubbles and vice versa for non-compliance.

- (a) Connect the Vapor Coupler Integrity Assembly to the Phase I vapor coupler. Connect the Vapor Coupler Test Assembly. Connect the nitrogen supply to the assembly and carefully pressurize the internal volume of the assembly to two (2.0) inches water column. Start the stopwatch. Record the final pressure after one minute.
- (b) If the pressure after one minute is less than 0.25 inches water column, the leakrate through the Phase I vapor poppet precludes conducting the static leak test at this location. If the pressure after one minute is greater than or equal to 0.25 inches water column, the static leak test may be conducted at this location. This criteria assures a maximum leakrate through the Phase I vapor poppet of less than 0.0004 cubic feet per minute.
- (c) Disconnect the Vapor Coupler Integrity Assembly from the Phase I vapor coupler. If the requirements of (b), above, were met, install the Vapor Coupler Test Assembly to the Phase I vapor coupler.
- (7) All pressure measuring device(s) shall be bench calibrated or field calibrated using either a reference gauge or incline manometer. Calibration shall be performed at 20, 50, and 80 percent of full scale. Accuracy shall be within two percent at each of these calibration points.
- (8) Use the flowmeter to determine the nitrogen regulator delivery pressures which correspond to nitrogen flowrates of 1.0 and 5.0 CFM. These pressures define the allowable range of delivery pressures acceptable for this test procedure. Also record which regulator delivery pressure setting, and the corresponding nitrogen flowrate, will be used during the test.
- (9) Use § 11.3 to calculate the approximate time required to pressurize the system ullage to the initial starting pressure of two (2.0) inches water column. This will allow the tester to minimize the quantity of nitrogen introduced into those systems which cannot comply with the static leak standards.

7.4 Check Equipment and Supplies

8 TEST PROCEDURE

- (1) Open the nitrogen gas supply valve and set the regulator delivery pressure within the allowable range determined in § 7.2 (8), and start the stopwatch. Pressurize the vapor system (or subsystem for individual vapor return line systems) to at least 2.2 inches water column initial pressure. It is critical to maintain the nitrogen flow until the pressure stabilizes, indicating temperature and vapor pressure stabilization in the tanks. Check the test equipment using leak detecting solution or a combustible gas detector to verify that all test equipment is leak tight.
 - (a) If the time required to achieve the initial pressure of two (2.0) inches water column exceeds twice the time derived from § 11.3, stop the test and use liquid leak detector, or a combustible gas detector, to find the leak(s) in the system.
 - (b) Repair or replace the faulty component(s) and restart the test pursuant to § 8 (1).
- (2) Close and disconnect the nitrogen supply. Start the stopwatch when the pressure has decreased to the initial starting pressure of two (2.0) inch water column.
- (3) At one-minute intervals during the test, record the system pressure. After five minutes, record the final system pressure. See the applicable of Tables 1 (or § 11.1) or 2 (or § 11.2) to determine the acceptability of the final system static pressure results. For intermediate values of ullage in Tables 1 and 2, linear interpolation may be employed.
- (4) If the system failed to meet the criteria set forth in Tables 1 and 2 (or the appropriate equation in § 11), repressurize the system and check all accessible vapor connections using leak detector solution or a combustible gas detector. If vapor leaks in the system are encountered, repair or replace the defective component and repeat the test. Potential sources of leaks include nozzle check valves, pressure/vacuum relief valves, containment box drain valve assemblies, and plumbing connections at the risers.
- (5) If the facility fails to comply with the static leak test standards and the Phase I system utilizes a non-CARB-certified drain valve equipped containment box, which was installed prior to July 1, 1992, for which a CARB-certified replacement drain valve assembly is not marketed, the following two subsections shall apply:
 - (a) The drain valve may be removed and the port plugged. Retest the system. If the facility complies with the static leak test standards under these conditions, the facility shall be considered complying with the requirements, provided that the manufacturer and model number of the containment box and the date of installation are submitted with the test results.
 - (b) The criteria set forth in (a), above, shall not apply after July 1, 1996.
- (6) After the remaining system pressure has been relieved, remove the "T" connector assembly and reconnect the vapor recovery hose, if applicable.
- (7) If the vapor recovery system utilizes individual vapor return lines, repeat the leak test for each gasoline grade. Avoid leaving any vapor return line open longer than is necessary to install or remove the "T" connector assembly.

9 QUALITY ASSURANCE / QUALITY CONTROL (QA/QC)

This section is reserved for future specification.

10 RECORDING DATA

The calculated ullage and system pressures for each five-minute vapor recovery system test shall be reported as shown in Figure 4 for example. Be sure to include the Phase I system type (two-point or coaxial), the Phase II system type, whether the system is manifolded, and the one-minute pressures during the test.

11 CALCULATING RESULTS

Use the applicable of Table 1 or 2, or the applicable of § 11.1 or § 11.2, to determine the compliance status of the facility by comparing the final five-minute pressure with the minimum allowable final pressure.

- (1) For balance Phase II systems use Table 1 to determine compliance.
- (2) For vacuum-assist Phase II systems use Table 2 to determine compliance.

11.1 Allowable Pressures for Balance Systems

For Phase II Balance Systems, the allowable five-minute final pressure, with an initial pressure of two inches of water column, shall be calculated as follows:

$$\begin{array}{llll} P_f = 2e^{-760.490/V} & \text{if} & N = 1-6 \\ P_f = 2e^{-792.196/V} & \text{if} & N = 7-12 \\ P_f = 2e^{-824.023/V} & \text{if} & N = 13-18 \\ P_f = 2e^{-855.974/V} & \text{if} & N = 19-24 \\ P_f = 2e^{-888.047/V} & \text{if} & N > 24 \end{array}$$

where:

N = the number of affected nozzles. For manifolded systems, N equals the total number of nozzles. For dedicated plumbing configurations, N equals the number of nozzles serviced by the tank being tested.

P_f = the minimum allowable five-minute final pressure, inches H_2O

V = the total ullage affected by the test, gallons

e = a dimensionless constant approximately equal to 2.718

2 = the initial starting pressure, inches H_2O

11.2 Allowable Pressures for Assist Systems

For Phase II Vacuum Assist Systems, the allowable five-minute final pressure, with an initial pressure of two (2.0) inches of water column, shall be calculated as follows:

$$\begin{array}{llll} P_f & = & 2e^{-500.887/V} & \text{if } N = 1-6 \\ P_f & = & 2e^{-531.614/V} & \text{if } N = 7-12 \\ P_f & = & 2e^{-562.455/V} & \text{if } N = 13-18 \\ P_f & = & 2e^{-593.412/V} & \text{if } N = 19-24 \\ P_f & = & 2e^{-624.483/V} & \text{if } N > 24 \end{array}$$

where:

N = the number of affected nozzles. For manifolded Phase II systems, N equals the total number of nozzles. For dedicated Phase II plumbing configurations, N equals the number of nozzles serviced by the tank being tested.

P_f = the minimum allowable five-minute final pressure, inches H_2O

V = the total ullage affected by the test, gallons

e = a dimensionless constant approximately equal to 2.718

2 = the initial starting pressure, inches H_2O

11.3 Allowable Time for 2"WC Pressurization

The minimum time required to pressure the system ullage to two (2.0) inches water column shall be calculated as follows:

$$t_1 = V/[1522F]$$

where:

t_1 = the minimum time to pressurize the ullage to two inches H_2O , minutes

V = the total ullage affected by the test, gallons

F = the nitrogen flowrate into the system, CFM

1522 = conversion factor for pressure and volume

11.4 Volumetric Leak Flow Rate

The following simple formula provides an estimate of volumetric leak flow rate, with acceptable bias and precision:

$$\Delta V/\Delta t = 0.1337 V [\Delta P/(P_a + 2)]/\Delta t$$

where:

$\Delta V/\Delta t$ = the volumetric leak flow rate, CFM

ΔV = the emitted volume, gallons

| | | |
|----------------|---|--|
| Δt | = | 5, minutes |
| ΔP | = | the two-minute pressure change during the test, inches H ₂ O |
| | = | 2 - P ₂ , inches H ₂ O |
| P _a | = | the atmospheric pressure during the test, inches H ₂ O |
| P ₂ | = | the final two-minute pressure change for the test, inches H ₂ O |
| 0.1337 | = | conversion factor for volume |

12 REPORTING RESULTS

12.1 Determination of Compliance

The static pressure performance standard is dependent upon several factors including ullage in the dispensing facility tanks and the number of associated nozzles. The performance standard for any specific combination of these factors is determined by application of the required test procedure.

The requirement for static pressure performance allows a finite pressure decay. Although § 8 of TP-201.3 provides for diagnosis and remediation of leaks after the initial application of TP-201.3 § 8 (1) through (3) in each operating mode, it is necessary to make a determination regarding compliance or non-compliance based upon the initial application of TP-201.3 for any series of tests. E.g.:

- (1) a determination of **compliance** is required if the criteria set forth in Tables 1 and 2 of TP-201.3 are **met** upon the initial application of TP-201.3 § 8 (1)-(3) in each operating mode.
- (2) a determination of **non-compliance** is required if the criteria set forth in Tables 1 and 2 of TP-201.3 are **not met** upon the initial application of TP-201.3 § 8 (1)-(3) in each operating mode.

12.2 Determination of Volumetric Leak Flow Rate

Application of standard engineering principles can yield the corresponding volumetric leak flow rate; such a determination is not a requirement of this procedure, but equations are provided in § 11 of TP-201.3 to facilitate volumetric leak flow rate estimates, as desired.

13 ALTERNATIVE TEST PROCEDURES

Test procedures, other than specified above, shall only be used if prior written approval is obtained from the ARB Executive Officer. In order to secure the ARB Executive Officer's approval of an alternative test procedure, the applicant is responsible for demonstrating to the ARB Executive Officer's satisfaction that the alternative test procedure is equivalent to this test procedure.

- (1) Such approval shall be granted on a case-by-case basis only. Because of the evolving nature of technology and procedures for vapor recovery systems, such approval shall not be granted in subsequent cases without a new request for approval and a new demonstration of equivalency.
- (2) Documentation of any such approvals, demonstrations, and approvals shall be maintained in the

ARB Executive Officer's files and shall be made available upon request.

14 REFERENCES (This section is reserved for future specification.)

15 EXAMPLE FIGURES, FORMS, AND TABLES

15.1 Figures

Each figure provides an illustration of an implementation which conforms to the requirements of this test procedure; other implementations which so conform are acceptable, too. Any specifications or dimensions provided in the figures are for example only, unless such specifications or dimensions are provided as requirements in the text of this or some other required test procedure.

Figure 1 Test Locations

Figure 2 Storage Tank Test Point 1 Vapor Coupler Integrity Assembly (without Poppet Rod)

Figure 3 Storage Tank Test Point 1 Vapor Coupler Test Assembly (with Poppet Rod)

Figure 4 Storage Tank Test Point 1 Storage Tank Pressure Assembly and Nitrogen Pressurization

Figure 5 Vapor Return Test Point 2 "T" Connector Assembly and Nitrogen Pressurization

Figure 6 Vent Test Point 3 Vent Cap Assembly

Figure 7 Vent Test Point 3 Vent Pipe Pressure Assembly and Nitrogen Pressurization

15.2 Forms

Each form provides an illustration of an implementation which conforms to the requirements of this test procedure; other implementations which so conform are acceptable, too. Any specifications or dimensions provided in the forms are for example only, unless such specifications or dimensions are provided as requirements in the text of this or some other required test procedure.

Form 1

Summary of Source Test Data

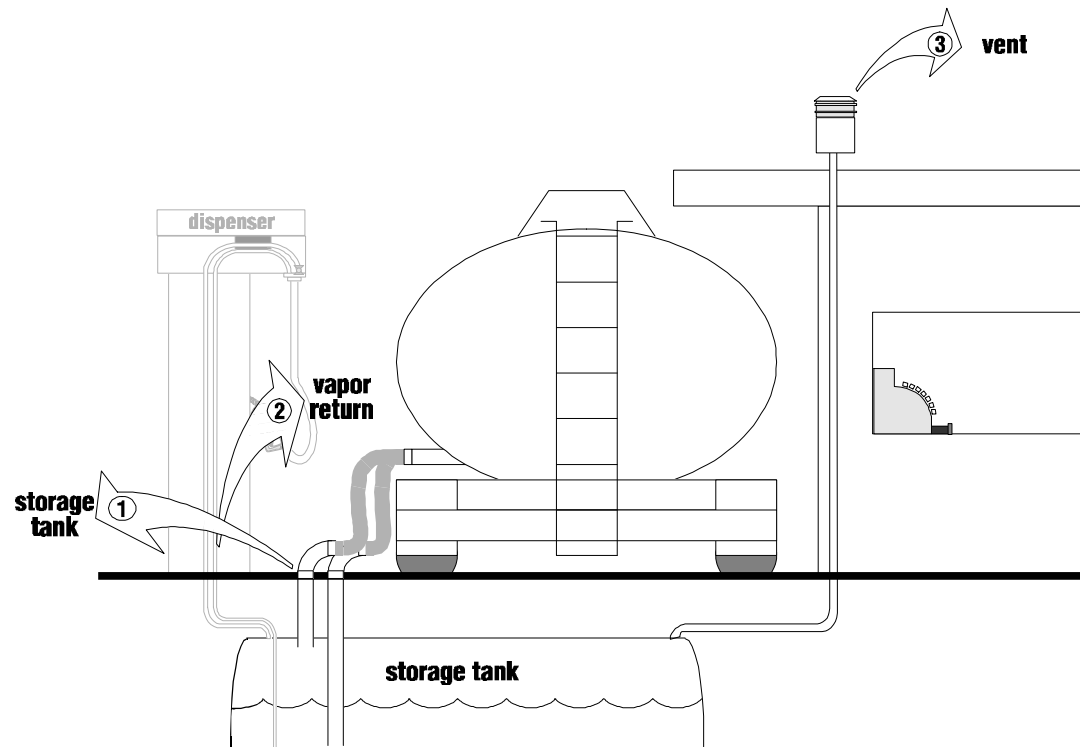
15.3 Tables

Each table provides an illustration of an implementation which conforms to the requirements of this test procedure; other implementations which so conform are acceptable, too. Any specifications or dimensions provided in the tables are for example only, unless such specifications or dimensions are provided as requirements in the text of this or some other required test procedure.

Table 1 **Phase II Balance Systems**

Table 2 **Phase II Assist Systems**

FIGURE 1
Test Locations



TP 201.3 F.1/B. CORDOVA '95

FIGURE 2
Phase I Vapor Coupler Integrity Assembly
(Without Poppet Rod)

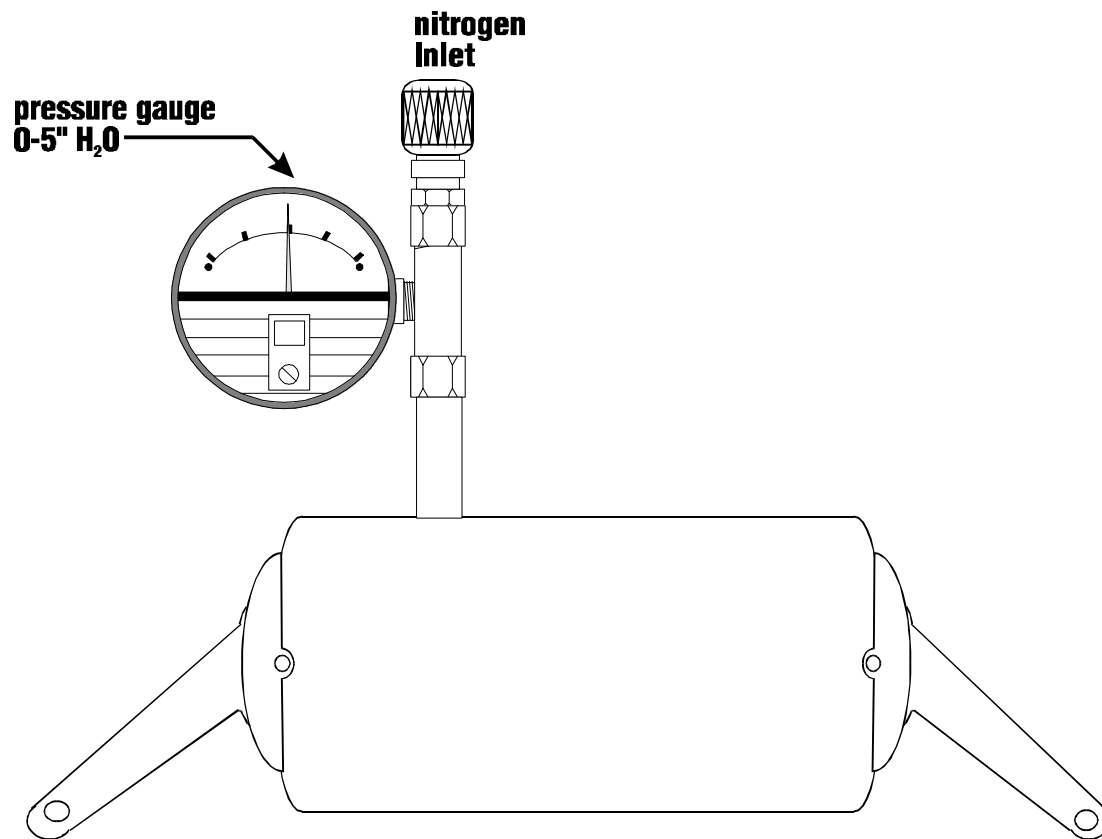


FIGURE 3
Phase I Vapor Coupler Integrity Assembly
(With Poppet Rod)

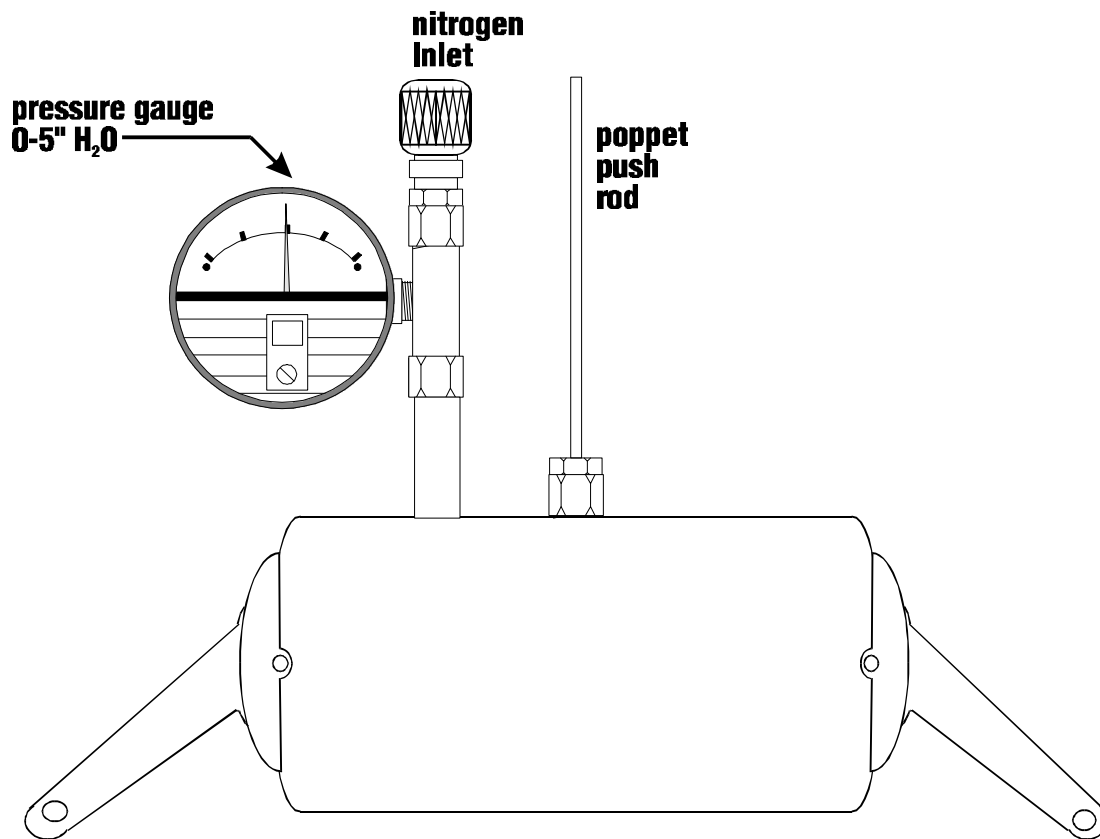
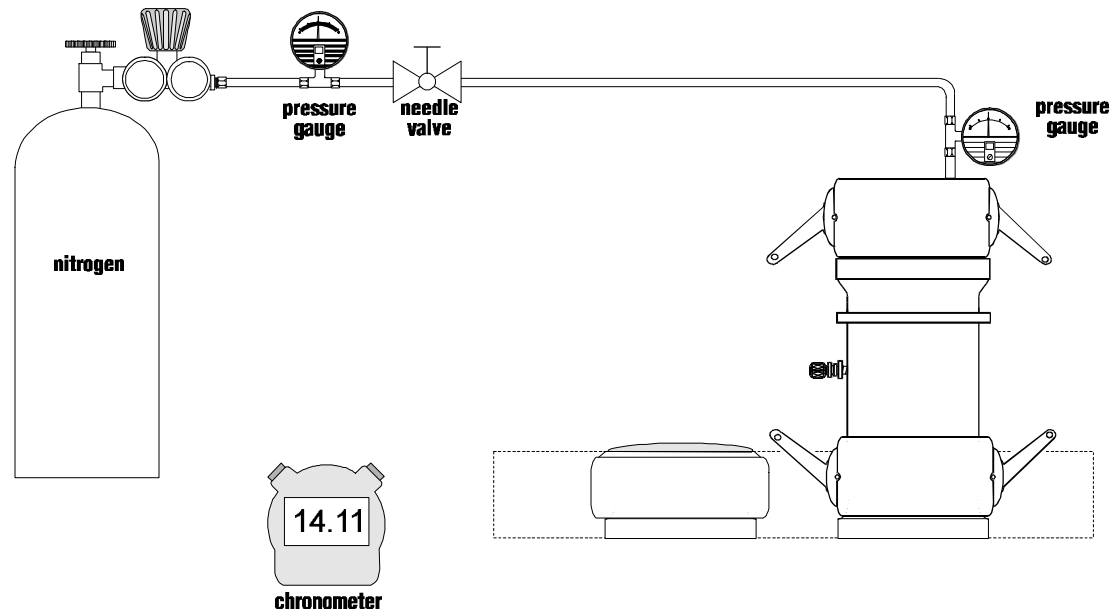
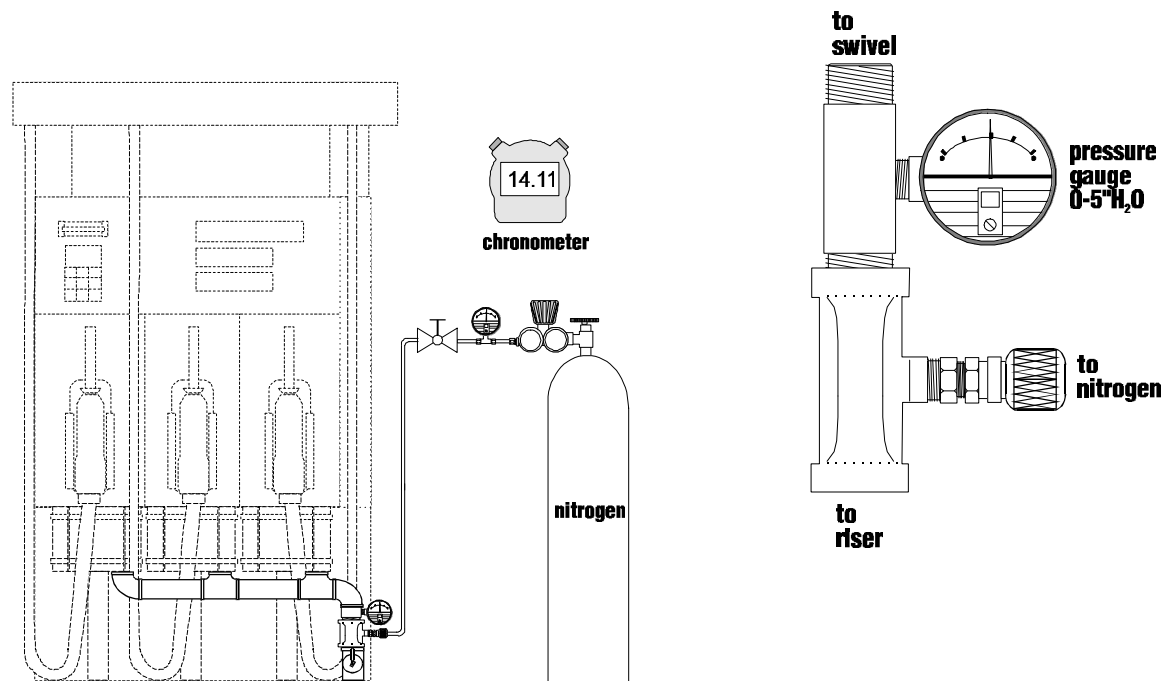


FIGURE 4
Storage Tank Test Location 1
Nitrogen Pressurization



TP 201.3 F.4/ R. CORDOVA '95

FIGURE 5
Vapor Return Test Location 2
"T" Connector Assembly and Nitrogen Pressurization



TP 201.3 F.5/ B. CORDOVA '95

FIGURE 6
Vent Test Location 3
Vent Cap Assembly

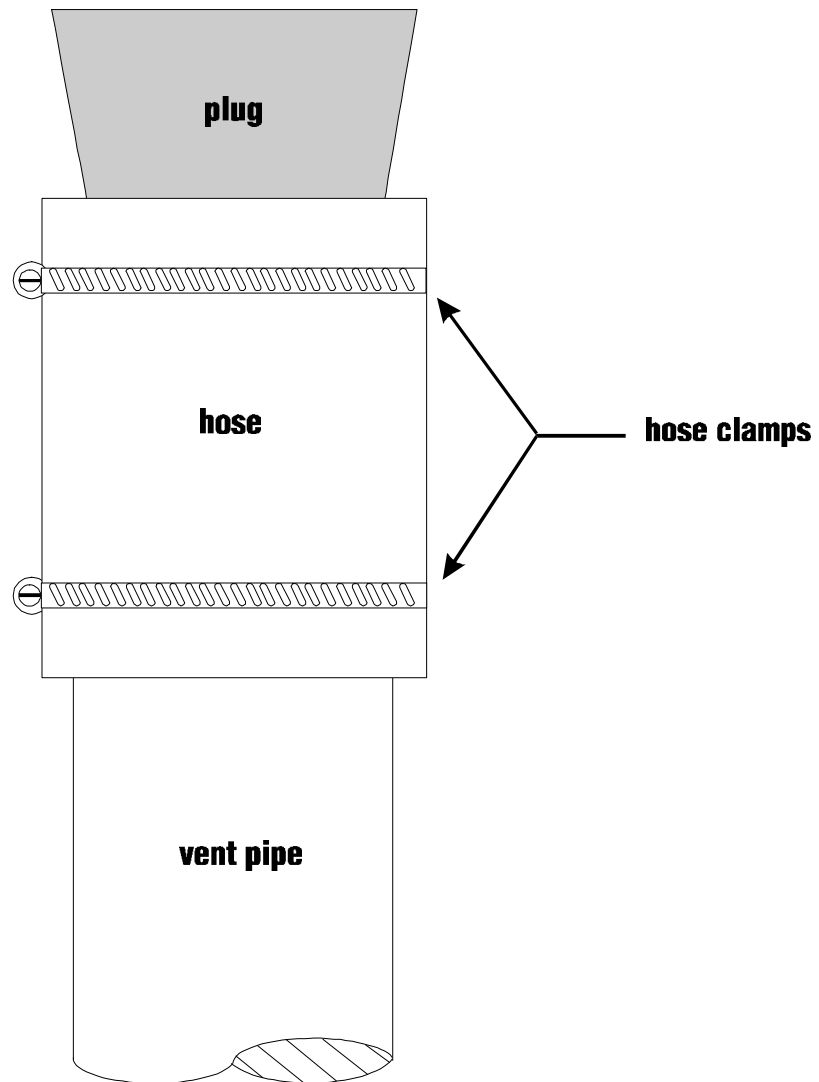
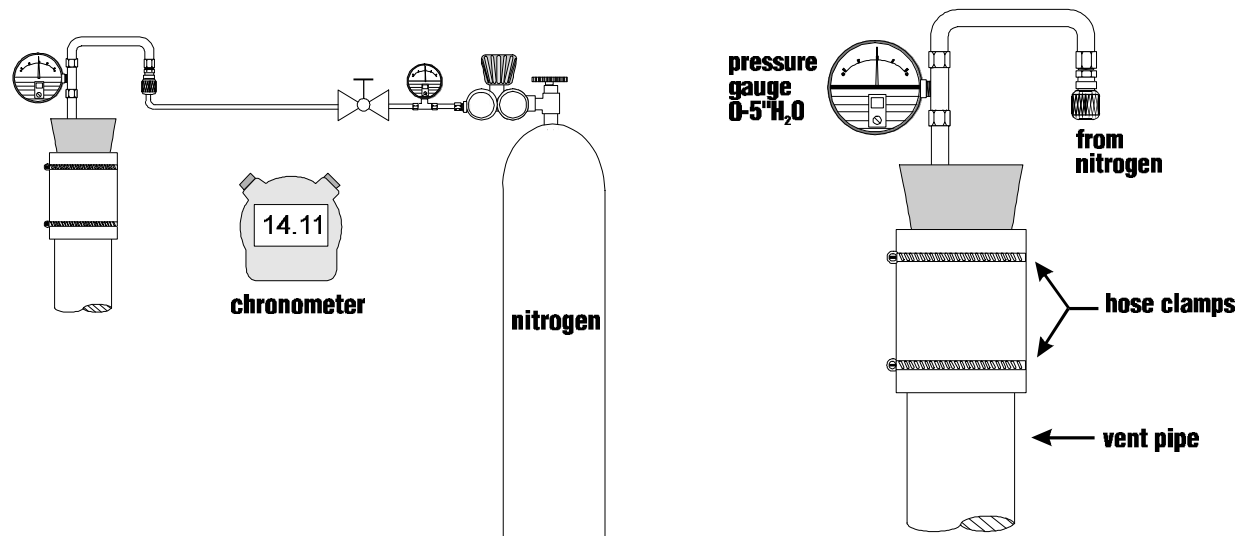


FIGURE 7
Vent Test Location 3
Vent Pipe Pressure Assembly and Nitrogen Pressurization



TP 201.3 F7/B, CONDOVA '95

TABLE 1**Phase II Balance Systems**

| ULLAGE (GALLONS) | NUMBER OF AFFECTED NOZZLES | | | | |
|---------------------|--|-------------|-------------|-------------|-------------|
| | 01-06 | 07-12 | 13-18 | 19-24 | >24 |
| | MINIMUM PRESSURE AFTER 5 MINUTES (INCHES OF H ₂ O) | | | | |
| 500 | 0.44 | 0.41 | 0.38 | 0.36 | 0.34 |
| 550 | 0.50 | 0.47 | 0.45 | 0.42 | 0.40 |
| 600 | 0.56 | 0.53 | 0.51 | 0.48 | 0.46 |
| 650 | 0.62 | 0.59 | 0.56 | 0.54 | 0.51 |
| 700 | 0.67 | 0.64 | 0.62 | 0.59 | 0.56 |
| 750 | 0.73 | 0.70 | 0.67 | 0.64 | 0.61 |
| 800 | 0.77 | 0.74 | 0.71 | 0.69 | 0.66 |
| 850 | 0.82 | 0.79 | 0.76 | 0.73 | 0.70 |
| 900 | 0.86 | 0.83 | 0.80 | 0.77 | 0.75 |
| 950 | 0.90 | 0.87 | 0.84 | 0.81 | 0.79 |
| 1,000 | 0.93 | 0.91 | 0.88 | 0.85 | 0.82 |
| 1,200 | 1.06 | 1.03 | 1.01 | 0.98 | 0.95 |
| 1,400 | 1.16 | 1.14 | 1.11 | 1.09 | 1.06 |
| 1,600 | 1.24 | 1.22 | 1.19 | 1.17 | 1.15 |
| 1,800 | 1.31 | 1.29 | 1.27 | 1.24 | 1.22 |
| 2,000 | 1.37 | 1.35 | 1.32 | 1.30 | 1.28 |
| 2,200 | 1.42 | 1.40 | 1.38 | 1.36 | 1.34 |
| 2,400 | 1.46 | 1.44 | 1.42 | 1.40 | 1.38 |
| 2,600 | 1.49 | 1.47 | 1.46 | 1.44 | 1.42 |
| 2,800 | 1.52 | 1.51 | 1.49 | 1.47 | 1.46 |
| 3,000 | 1.55 | 1.54 | 1.52 | 1.50 | 1.49 |
| 3,500 | 1.61 | 1.59 | 1.58 | 1.57 | 1.55 |
| 4,000 | 1.65 | 1.64 | 1.63 | 1.61 | 1.60 |
| 4,500 | 1.69 | 1.68 | 1.67 | 1.65 | 1.64 |
| 5,000 | 1.72 | 1.71 | 1.70 | 1.69 | 1.67 |
| 6,000 | 1.76 | 1.75 | 1.74 | 1.73 | 1.72 |
| 7,000 | 1.79 | 1.79 | 1.78 | 1.77 | 1.76 |
| 8,000 | 1.82 | 1.81 | 1.80 | 1.80 | 1.79 |
| 9,000 | 1.84 | 1.83 | 1.83 | 1.82 | 1.81 |
| 10,000 | 1.85 | 1.85 | 1.84 | 1.84 | 1.83 |
| 15,000 | 1.90 | 1.90 | 1.89 | 1.89 | 1.89 |
| 20,000 | 1.93 | 1.92 | 1.92 | 1.92 | 1.91 |

Note: For manifolded Phase II Balance Systems, the "Number of Affected Nozzles" shall be the total of all gasoline nozzles. For dedicated return configurations, the "Number of Affected Nozzles" shall be the total of those nozzles served by the tank being tested.

TABLE 2
Phase II Assist Systems

| ULLAGE (GALLONS) | NUMBER OF AFFECTED NOZZLES | | | | |
|---------------------|--|-------------|-------------|-------------|-------------|
| | 01-06 | 07-12 | 13-18 | 19-24 | >24 |
| | MINIMUM PRESSURE AFTER 5 MINUTES (INCHES OF H ₂ O) | | | | |
| 500 | 0.73 | 0.69 | 0.65 | 0.61 | 0.57 |
| 550 | 0.80 | 0.76 | 0.72 | 0.68 | 0.64 |
| 600 | 0.87 | 0.82 | 0.78 | 0.74 | 0.71 |
| 650 | 0.93 | 0.88 | 0.84 | 0.80 | 0.77 |
| 700 | 0.98 | 0.94 | 0.90 | 0.86 | 0.82 |
| 750 | 1.03 | 0.98 | 0.94 | 0.91 | 0.87 |
| 800 | 1.07 | 1.03 | 0.99 | 0.95 | 0.92 |
| 850 | 1.11 | 1.07 | 1.03 | 1.00 | 0.96 |
| 900 | 1.15 | 1.11 | 1.07 | 1.03 | 1.00 |
| 950 | 1.18 | 1.14 | 1.11 | 1.07 | 1.04 |
| 1,000 | 1.21 | 1.18 | 1.14 | 1.10 | 1.07 |
| 1,200 | 1.32 | 1.28 | 1.25 | 1.22 | 1.19 |
| 1,400 | 1.40 | 1.37 | 1.34 | 1.31 | 1.28 |
| 1,600 | 1.46 | 1.43 | 1.41 | 1.38 | 1.35 |
| 1,800 | 1.51 | 1.49 | 1.46 | 1.44 | 1.41 |
| 2,000 | 1.56 | 1.53 | 1.51 | 1.49 | 1.46 |
| 2,200 | 1.59 | 1.57 | 1.55 | 1.53 | 1.51 |
| 2,400 | 1.62 | 1.60 | 1.58 | 1.56 | 1.54 |
| 2,600 | 1.65 | 1.63 | 1.61 | 1.59 | 1.57 |
| 2,800 | 1.67 | 1.65 | 1.64 | 1.62 | 1.60 |
| 3,000 | 1.69 | 1.68 | 1.66 | 1.64 | 1.62 |
| 3,500 | 1.73 | 1.72 | 1.70 | 1.69 | 1.67 |
| 4,000 | 1.76 | 1.75 | 1.74 | 1.72 | 1.71 |
| 4,500 | 1.79 | 1.78 | 1.77 | 1.75 | 1.74 |
| 5,000 | 1.81 | 1.80 | 1.79 | 1.78 | 1.77 |
| 6,000 | 1.84 | 1.83 | 1.82 | 1.81 | 1.80 |
| 7,000 | 1.86 | 1.85 | 1.85 | 1.84 | 1.83 |
| 8,000 | 1.88 | 1.87 | 1.86 | 1.86 | 1.85 |
| 9,000 | 1.89 | 1.89 | 1.88 | 1.87 | 1.87 |
| 10,000 | 1.90 | 1.90 | 1.89 | 1.88 | 1.88 |
| 15,000 | 1.93 | 1.93 | 1.93 | 1.92 | 1.92 |
| 20,000 | 1.95 | 1.95 | 1.94 | 1.94 | 1.94 |

Note: For manifolded Phase II Assist Systems, the "Number of Affected Nozzles" shall be the total of all gasoline nozzles. For dedicated return configurations, the "Number of Affected Nozzles" shall be the total of those nozzles served by the tank being tested.